A PRE-HARVEST ASSESSMENT

Student Handbook

Canada Alberta

Partnership Agreement in Forestry
Entente d'association en foresterie

Pre-harvest Ecological Assessment Handbook

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15 December 1994

Pub. No.: Ref. 96
ISBN: 0-7732-1411-9

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1.1 INTRODUCTION

To facilitate forest ecosystem management, it is necessary to have a standardized and structured site assessment system that can be readily applied in the field. The information gathered from such field based assessments can potentially be used by a variety of resource managers, particularly foresters in assessing forest stands prior to harvesting. It is hoped that development of an ecological assessment system will improve forest management in Alberta. This handbook represents the first of at least two guides oriented towards the assessment and interpretation of forest ecosystems. The second module will involve the interpretation of the ecological data as it relates to site harvesting and reforestation.

This handbook is divided into three sections.

1. Introduction to the Ecological Assessment System;
2. Criteria and Terminology used to complete the Ecological Assessment Form; and
3. Pre-field Preparation.

It is strongly suggested that students and potential users of the system read through all of this material prior to attending a Pre-harvest Ecological Assessment training course, or attempting to complete the Ecological Assessment Form.

This handbook contains most of the technical information that is needed for the classroom portion of this course, but you will also require the following materials:

- a pencil; and
- a field guide to local forest ecosystems.

For the field portion of this course and the day-to-day collection of field data, you may also require the following materials and equipment:

- metric ruler;
- clinometer;

- field compass;
- an inexpensive knife for digging in the soil;
- a couple of ziplock plastic bags for collecting unknown plants;
- increment borer;
- a small bottle of 10% HCl;
- a squeeze bottle of water;
- Munsell Soil Color Chart (optional);
- shovel;
- plant identification book(s); and
- Ecological Assessment Forms.

1.2 COURSE OBJECTIVES

Because there are substantial costs associated with each phase of the harvesting and reforestation process, and a pre-harvest assessment is critical to the total success of plantation establishment, foresters want well-trained personnel assessing sites prior to harvesting.

This course will make the forestry practitioner aware of the latest information and techniques for doing site assessment. With this information, he or she can help enhance the planning, site preparation, and nursery culture phases as well as the harvesting event.

The overall goals of this course are to:

1. Improve forest management in Alberta by providing an ecologically oriented pre-harvest assessment system to assist in planning and carrying out effective reforestation.

2. Provide field staff with a standard approach and criteria for site assessment, as well as ecological assessment training.

1.3 DACUM COMMITTEE

The objectives and content of this course were developed through a consensus process called DACUM, "Develop-A-CUrriculuM". The Environmental Training Centre passes on its appreciation and thanks to the following individuals who contributed their time and expertise to the development of this course.

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2.1 INTRODUCTION

The phrase "Ecological Assessment" in this handbook refers to the process of evaluating a site, according to a specific set of procedures, to accomplish certain forest management objectives. Such objectives might include identification of potential hazard areas, or facilitation of linking harvesting and reforestation systems. This assessment system uses an ecological approach to site evaluation as opposed to a single variable or very restricted set of variables (e.g., just soils data). Ecological assessment represents one component in an overall system for site assessment and monitoring.

2.2 ADVANTAGES OF A PRE-HARVEST ECOLOGICAL ASSESSMENT SYSTEM

Use of pre-harvest ecological assessment system has both short-term and long-term advantages. In Alberta, it is expected that this system will be used for the following short-term purposes:

- **link** harvesting and reforestation systems;
- determine **whether to log** or not;
- **match** the site to an appropriate site preparation technique;
- choose the **right season** for logging;
- flag out **potential hazards** associated with logging (e.g., flooding areas);
- **reduce costs** by increasing the success rate of reforestation; and
- **prime site management** such as deployment of genetically improved stock, fertilizing, etc.

In the future, the Ecosystem Assessment system will be used for -

- **communication** about forest ecosystems using a standard system and a common language.

- **evaluation** of silvicultural

prescriptions that will be developed, assessed, and monitored on a forest ecosystem basis.

- **learning** information about particular forest ecosystems, so data can be catalogued and communicated, and appropriate treatments can be recommended on similar ecosystems in different parts of the province.

2.3 REASONS FOR COLLECTING ECOLOGICAL ASSESSMENT DATA

Ecology is the study of biological entities and their relationship to the physical environment and other organisms. Ecological systems are called "ecosystems". Ecosystems such as forests are complex natural entities and their successful management depends on an understanding of how they function. Clues to how a stand should be managed are potentially available in the forest stand itself, its understory vegetation, on the forest floor, and in the soils that support the trees. These clues include conditions that could both promote (e.g., an appropriate nutrient regime) and inhibit (e.g., competing vegetation) the re-establishment of a healthy forest stand.

Use of the ecosystem concept provides a logical approach for studying forests, summarizing data, and testing silvicultural management systems, since similar forest ecosystems have similar site conditions, and therefore should respond similarly to a given management strategy. Once one or more successful approaches to managing a given forest type have been recognized, it could provide foresters with a range of proven options for managing new sites. The forest ecosystem approach also provides an experimental framework for developing and testing potential management strategies to minimize problems such as reedgrass (*Calamagrostis canadensis*) competition and to optimize management objectives.

At present, however, insufficient information exists on the types of forest ecosystems that occur in Alberta, their site conditions, and the potential problems and limitations associated with these ecosystems. Establishment of a pre-harvest assessment process will help develop a more ecological and scientifically oriented forest

management system for Alberta. This process will also lead to the development of tested silvicultural prescriptions. Development of an ecologically oriented forest management systems will necessitate the systematic collection of selected site and vegetation data. Currently, field guides to forest ecosystems are available for the west-central (Corns and Annas 1986, under revision), the northwest (Beckingham 1994), and southwest (Anonymous 1994a, draft) portions of the province.

2.4 OBJECTIVES

Before leaving this course, students shall be proficient at:

1. Data collection as needed for the Ecological Assessment Form.

   More specifically, students should be able to:

   - recognize Natural Regions and Subregions within Alberta;
   - adequately describe terrain;
   - classify the organic component of soils;
   - classify drainage regimes;
   - locate water tables, evidence of a fluctuating water table, high abundances of carbonates, and effective rooting depth;
   - determine differences in soil texture;
   - perform hand-texturing;
   - summarize the percent cover of tree species;
   - recognize and name 40 to 50 common forest understory plant species; and
   - summarize the percent cover of common forest understory plant.

2. Properly complete an Ecological Assessment Form.

The next section of this course deals with the terminology and criteria used in the completion of the Ecological Assessment Form. Once a review of this information has been completed, students will have the opportunity to familiarize themselves with the form and the assessment criteria in a field setting. Several study sites with different soil and vegetation conditions will be examined.

2.5 THE ECOLOGICAL ASSESSMENT FORM

The following two pages represent the form that was developed for the Pre-harvest Ecological Assessment course and multiple copies are available from the Environmental Training Centre (Table 1). It consists of five sections -

. **location information** -- .This information is critical to the systematic cataloguing and monitoring of assessments.

. **site information** -- This section of the form summarizes general information about the site such as terrain characteristics, parent materials, and forest floor substrates.

. **soils information** -- This section of the form summarizes general conditions that occur below the ground surface. To complete this section, it will be necessary to examine various soil attributes such as organic layer of the forest floor, moisture conditions, and physical and biological aspects of the mineral portion of the soil.

. **vegetation information** -- This section consists of two components. The first is a summary of tree composition by species in the overstory and understory. The second portion of this section (back of first side) requires an assessment of non-tree species that occur beneath the forest canopy.

. **site classification** -- This section of the form represents a synthesis of selected site, soil, and vegetation data.

Table 1. Ecological Assessment Form.

page ____ of ____

Licence No. _____ Location Twp ___ Rg ___ Mer ___ Sec ___ Lsd ___ Date Year ___ Month ___ Day ___

Plot No. _____ Surveyed by _____

UTM z_____e_____n_____ Lat. _____ / Long. _____

SITE

Elevation _____ m
Aspect _____ degrees
Slope _____ %

Surface Expression H I L M R S T U
Slope Position c u m l t d e
Parent Material M L E F GF O R C

	Decaying Wood	Bedrock	Cobbles and Stones	Mineral Soil	Organic Matter	Water
Substrate %						

SOILS

Duff Depth _____ cm
Humus Frm. Mor Moder Mull

Decomp. Org. Soils Of Om Oh

Seepage Y N S

Drainage VR R W MW I P VP

Soil Pit Depth _____ cm

Depth to:
Water ____ cm (from top of forest floor)
Mottles ____ cm Perched Y N
Gleying ____ cm
Calcar. ____ cm (variables measured from
ERD ____ cm mineral/organic interface)
Bedrock ____ cm

Layer 1:
Texture _____ Ah Y N
Coarse Frag. % 0 <5 <20 <40 <60 <80 >80
Coarse Frag. Type G C S B

Layer 2:
Depth to _____ cm
Texture _____ Ahb Y N
Coarse Frag. % 0 <5 <20 <40 <60 <80 >80
Coarse Frag. Type G C S B

Layer 3:
Depth to _____ cm
Texture _____ Ahb Y N
Coarse Frag. % 0 <5 <20 <40 <60 <80 >80
Coarse Frag. Type G C S B

Total Ah(b) <2 cm thick _____

VEGETATION

AVI Cover Type _____ Stand Age _____ yr

Vegetation Structure	SW	SE	SB	PL	PJ	FB	FA	LT	FD	AW	PB	BW				
Main Canopy																
Understory >10 m																
Understory 4 - 10 m																
Understory <4 m																

Cover Classes (%) A: <1 B: 1 - 5 C: 6 - 20 D: 21 - 50 E: >50

SITE CLASSIFICATION

Subregion	MR - 1 2 3 4 5 6 7 8	NR - A B C D E	Ecosite Code
Field Guide	19	Ecosite Code Fit	Good Fair Poor

Comments _____

Understory Vegetation

SHRUBS		C.C.
Ground Juniper	JUNICOM	
Bearberry	ARCTUVA	
Bog Cranberry	VACCVIT	
Labrador Tea	LEDUGRO	
Blueberry	VACCMYR	
Tall Bilberry	VACCMEM	
Saskatoon	AMELALN	
Canadian Buffaloberry	SHEPCAN	
Beaked Hazelnut	CORYCOR	
Prickly Rose	ROSAACI	
Low-bush Cranberry	VIBUEDU	
White Rhododendron	RHODALB	
Wild Red Raspberry	RUBUIDA	
Bristly Black Currant	RIBELAC	
Wild Red Currant	RIBETRI	
Wild Gooseberry	RIBEOXY	
Pin Cherry	PRUNPEN	
Choke Cherry	PRUNVIR	
Snowberry	SYMPALB	
Bracted Honeysuckle	LONIINV	
Twinning Honeysuckle	LONIDIO	
Green Alder	ALNUCRI	
Devil's Club	OPLOHOR	
Red Osier Dogwood	CORNSTO	
Willows	SALISPP	
Dwarf Birch	BETUGLA	
Small Bog Cranberry	OXYCMIC	

MOSSES/LICHENS		C.C.
Hair Cap Moss	POLYCOM	
Schreber's Moss	PLEUSCH	
Stairstep Moss	HYLOSPL	
Knight's Plume Moss	PTILCRI	
Peat Mosses	SPHASPP	
Reindeer Lichen	CLADSPP	
Green Dog Lichen	PELTSPP	

HERBS		C.C
Stiff Clubmoss	LYCOANN	
Showy Aster	ASTECON	
Lindley's Aster	ASTECIL	
Heart-leaved Arnica	ARNICOR	
Wild Strawberry	FRAGVIR	
Bunchberry	CORNCAN	
Fireweed	EPILANG	
Twinflower	LINNBOR	
Northern Bedstraw	GALIBOR	
Cream-color Vetchling (peavine)	LATHOCH	
Wild Vetch	VICIAME	
Common Pink Wintergreen	PYROASA	
Veiny Meadow Rue	THALVEN	
Lily-of-the-Valley	MAIACAN	
Tall Mertensia	MERTPAN	
Wild Sarsaparilla	ARALNUD	
Dewberry	RUBUPUB	
Sweet-scented Bedstraw	GALITRI	
Palmate-leaved Coltsfoot	PETAPAL	
Bishop's Cap	MITENUD	
Kidney-leaved Violet	VIOLREN	
Twisted Stalk	STREAMP	
Five-leaved Bramble	RUBUPED	
Oak Fern	GYMNDRY	
Woodland Horsetail	EQUISYL	
Common Horsetail	EQUIARV	
Meadow Horsetail	EQUIPRA	
Dwarf Scouring Rush	EQUISCI	
Cloudberry	RUBUCHA	
Marsh Marigold	CALTPAL	

GRASSES/SEDGES		C.C
Hairy Wild Rye	ELYMINN	
Marsh Reed Grass	CALACAN	
Sedges	CARESPP	

C.C. -- Cover Classes (%) A: <1 B: 1 - 5 C: 6 - 20 D: 21 - 50 E: >50

Note: Species are arranged roughly by moisture regimes, dry (top) to wet (bottom). ELS - 15 December 1984

3.0 CRITERIA AND TERMINOLOGY USED TO COMPLETE THE ECOLOGICAL ASSESSMENT FORM

3.1 INTRODUCTION

A standardized form that identifies various site factors, or the "Ecological Assessment Form", is the primary tool used to summarize ecological conditions as part of the ecological assessment process. It is also the primary focus of this course. The Ecological Assessment Form was developed in consultation with the Pre-harvest Assessment Committee through a consensus process to identify the most important factors that need to be collected in the field. The emphasis was placed upon site, soils, and vegetation factors. The following sections review the material you will need to know to competently complete the Pre-harvest Ecological Assessment Form. Whenever you see a word with "*italicized*" and underscored letters, these represent coded words or symbols used on the form.

In order for the silviculture forester or technologist to meet future forest ecosystem management objectives, it will be necessary to have a sound understanding of the factors that affect the site. Site is defined as "the sum total of the biotic and abiotic factors that affect the growth and development of plants".

The biotic (living) site features include the flora (vegetation), fauna (animals), and microbia (fungi, algae, actinomycetes, bacteria). The abiotic features in this context include the soil, climate, and physiography.

Determination of the site features entails measuring and/or describing, where possible, those biotic and abiotic factors which would influence the growth and development of the forest. It has been found that the following order of information collection allows for the efficient use of time in the site assessment process:

- Describe the **physiographic features**
- Identify the **soil characteristics**
- Determine the **nutrient regime**

- Determine the **moisture regime**
- Characterize the **vegetation**
- Classify the **forest ecosystem**
- Determine the **limiting factors** affecting tree growth on the site

However, to minimize confusion and to facilitate the systematic review of the Ecological Assessment Form, the five main sections will be reviewed in order of their occurrence on the form.

3.2 CRITERIA FOR ECOLOGICAL ASSESSMENT FORM

3.2.1 LOCATION Information

The header section at the top of the Ecological Assessment Form identifies several basic pieces of information that all forms must have to be useful to surveyors in the present as well as the future. The required data is relatively self-explanatory but it is important that the information be provided in a proper format. Without proper and full completion of this basic information, it could potentially invalidate its future usefulness. The requested information includes the following:

- *License No.* -- Record the forest harvesting License Number.

- *Plot No.* -- Record the plot number. These should be identified by sequential numbers within a given Licence Number (i.e., Plot 1, 2, 3 . . . License Number 101; Plot 1, 2, 3 . . . Licence Number 102). If more than one assessment of an area occurs during discontinuous field survey periods, an attempt should be made to not repeat previously used plot numbers within the same Licence area.

- *Location* -- Record the location of the field surveyed site according to Township (Twp), Range (Rg), Meridian (Mer), Section (Sec), and Legal Subdivision (Lsd). This notation should relate specifically to the location where the analysis was conducted.

- *Surveyed by* -- Record the first and last name of the surveyor. Initials should not be used, since they may not be known in the future and different people can have the same initials.

- *Date* -- The date of survey should be recorded using

numbers in the following sequence - Year, Month, and Day. The reason for recording the date information in this sequence is to avoid a potential confusion between the month and day (i.e., 94/6/8 - June 8, 1994 rather then August 6, 1994). Use of numbers to represent month avoids the potential problem of confusing months with similar first letters (e.g., June, July; March, May).

- *page ____ of ____* -- Record the number of pages included in the specific site assessment. While there may only be one Ecological Assessment Form, other related assessment forms may also be appended (e.g., Pre-harvest Assessment Form).

- *UTM* -- This category is primarily provided for surveyors who use GPS (Global Positioning System) equipment that outputs locations in Universal Transverse Mercator grid coordinates. This data can also be obtained from most current NTS map sheets, if the plot can be precisely located. Record the zone (*z*), easting (*e*), and northing (*n*) values for the plot location.

- *Lat. ____ / Long. ____* -- This category is primarily provided for surveyors who use GPS (Global Positioning System) equipment that outputs locations in latitude and longitude. This data can also be obtained from NTS map sheets, if the plot can be precisely located. Record plot location to the nearest second.

3.2.2 SITE Information

A variety of data are required to complete this section of the Ecological Assessment Form including topographic, landform, and forest floor characteristics. The following summarizes the selection options available within each category and some background information to assist surveyors with making appropriate selections.

- *Elevation* -- Record the topographic elevation of the assessed site. This can be initially determined through the use of contour maps, and then determined more accurately in the field, through extrapolation, and/or using an altimeter. If the site is highly variable in elevation, use the center of the study site for

measurement. Elevation is expressed in metres.

. *Aspect* -- Aspect is the orientation of a slope. Using a compass, determine this value to the nearest degree (i.e., 1 and 360 degrees) and record it in the appropriate space. The purpose of using numerical values as opposed to directions (e.g., NW or SE) is to facilitate data analysis.

. *Slope %* -- Determine the percent slope of the site using a clinometer and record in the appropriate space.

. *Surface Expression* -- Surface expression refers to the shape or form of the land surface. The Canadian Soil Survey Committee (Anonymous 1987) recognizes twelve surface expression types, and eight of these have been adapted to the Ecological Assessment system. These different surface expression categories are defined as follows-

H (Hummocky) -- Land that consists of a series of knobs (rounded hills) and kettles (small depressions), with slopes ranging from 6 to 70 percent.

I (Inclined) -- A single, simple, unidirectional slope with a gradient of 2 to 70 percent.

L (Level) -- Flat or very gently sloping, unidirectional surface, without undulations, up to 2 percent slope.

M (Rolling) -- A series of elongated ridges (i.e., alternating ridges and troughs) at least 1.6 km (1 mile) in length, with side slope gradients of more than 5 percent.

R (Ridged) -- Usually a narrow, elongate topographic features which is elevated above the surrounding terrain and has steep side slopes and a relatively narrow crest.

S (Steep) -- Slopes with gradients greater than 70 percent slope.

T (Terraced) -- Land that consists of a series of flat areas separated by narrow steep slopes (e.g., river terraces).

U (Undulating) -- A series of parallel slopes with lengths in the order of 0.8 km (0.5 miles) and gradients of 2 to 5 percent. Also

a subdued form of hummocky terrain.

When selecting a Surface Expression category assess the area around the study site (e.g., 1 km radius) and determine within what type of general land system it occurs. For example, is the study site located on a broad plain or in foothills topography or in the mountains, or within a river drainage course? If the study site occurs on a broad plain, what type of surface does it have? (e.g., hummocky, level, rolling, or undulating). If the study site occurs within a smaller but distinctive landscape feature such as a ravine, is it located on the steep side slopes, or on terraces or the floodplain at the bottom of the ravine walls? (i.e., Steep or Terraced, respectively, in this specific example).

- *Slope Position* -- Identify the topographic position of the study site according to the following categories -

c (Crest) -- The convex uppermost portion of a hill, usually with no distinctive aspect.

u (Upper Slope) -- The upper portion of a slope immediately below the crest.

m (Mid-Slope) -- The area of a slope between the upper and lower slope positions.

l (Lower Slope) -- The area towards the base of a slope, usually with a concave surface.

t (Toe of Slope) -- An area with a slight slope at the base of a hill, demarcated by an abrupt decrease in gradient.

d (Depression) -- An area that is concave in all directions, often at the foot of a hill or in a generally level area.

e (Level) -- An area that generally lacks a distinctive aspect.

- *Parent Material* -- Parent materials are the deposits resulting from various landscape creating and destroying processes. Such processes occur in response to erosion and/or deposition action related to water, wind, ice, gravity, or *in-situ* decomposition. Within this category occur eight different

types of parent materials -

M (Moraine) -- **Materials which have been transported by glacial ice**. These material are also known as till. Such deposits are often poorly sorted (i.e., consist of a mixture of particle sizes ranging from clay to boulders) and are unstratified (i.e., not consisting of distinctive zones of similarly sized materials). Topographically, morainal deposits often have an irregular surface that range from undulating to hummocky, but also occur as plains and distinctive ridges.

L (Lacustrine) -- **Sediments deposited in standing water**. These materials are usually fine-textured (i.e., very fine sand to clays), sorted into relatively uniform particle sizes, that often show evidence of banding. Near the shoreline of a lake, bands of sand often occur between bands of finer deposits. Within the shoreline zone, beach deposits and wave cut slopes may be present. The topography is often a relatively uniform plain or long slope, if the deposits are thick enough to mask the underlying terrain.

E (Eolian) -- Eolian deposits consist of **materials moved by wind**. These deposits are often well sorted and primarily consist of medium to fine sands. They do not normally show evidence of banding or differential deposition. Sand dunes are a common example of this type of parent material. In areas bordering dune fields, a thin layer of eolian sand is often present over other materials such as moraine or lacustrine deposits. Eolian deposits are often found in association with glacio-fluvial deposits. Silty textured eolian deposits (loess) are sometimes found on terraces adjacent to major rivers.

F (Fluvial) -- Fluvial parent materials and landforms are **developed through the actions of flowing water** (i.e., rivers, streams). The types of materials and landforms associated with these geomorphic features are highly variable. Common examples of fluvial features include river terraces, banks between terraces and along modern streams, meander scars and oxbows (i.e., abandoned portions of a river channel), and alluvial fan (i.e., fan-shaped

deposits from a stream where an abrupt decrease in the stream gradient occurs).

GF (Glacio-fluvial) -- Glacio-fluvial deposits are formed by the same processes that create **fluvial features**, but they were **created during glacial times** and are no longer subject to fluvial processes. Outwash plains are a common glacio-fluvial parent material. Such deposits are often coarse textured (e.g., sands and gravels) and stratified (e.g., bands of material of similar texture). Shallow outwash or erosional lag materials also occur over other material such as moraine. Outwash channels represent common erosional features.

O (Organic) -- Organic deposits develop from the long-term **accumulation of plant materials**. Such accumulations most commonly occur in depressions with standing water, where decomposition is slower than the accumulation rate. An accumulation of organic matter is considered an organic deposit if it is greater than 10 cm thick when it occurs over bedrock, or greater than 40 cm when it occurs over mineral deposits (e.g., moraine).

R (Residuum) -- Residuums are mineral based parent materials developed in response to the **weathering of bedrock**, in contrast to other parent materials which are transported to their present location by wind, water, gravity, or glaciers. In Alberta, such parent materials are most common in the Rocky Mountains at mid and upper elevations.

C (Colluvium) -- Colluvial materials are formed in response to the **downslope movement of materials due to gravity**. This process is often referred to as mass wasting. These materials have the same composition as the source area. Examples of such landforms include slumps or slope failures, and talus slopes.

If you are unfamiliar with the parent materials within your study area, surficial geology maps, physical and ecological land classification maps, and sometimes soil surveys can be very helpful in providing an overview of the local geomorphology. **For the Ecological Assessment Form,**

it is necessary to assign the study site to one of the above parent material categories.

. *Substrate %* -- This SITE information category consists of six separate components. Estimation of percent coverage for these categories is based only on what is exposed at the forest floor. Estimate values to the nearest five percent. More precise estimates are appropriate, particularly when percentages are less than five percent.

Decaying Wood -- Determine and record the percentage of decaying wood by including fallen trees, large branches on the ground surface, and partially-buried stumps with an exposed edge. This generally does not include freshly fallen material that has not yet begun to decompose. These materials may be covered with mosses, lichen, liverworts, or other plants. However, if an organic layer (e.g., LFH) has developed over the decaying wood, the decaying wood must exceed 10 cm in diameter, or else the wood is classified as Organic Matter.

Bedrock -- Record the percentage of exposed bedrock at the ground surface not covered by mineral or organic matter in excess of 2 cm in thickness.

Cobbles and Stones -- Record the percentage of ground cover with exposed rock fragments >7.5 cm in diameter and not covered by mosses, lichens, liverworts, or an organic layer more than 2 cm in thickness.

Mineral Soil -- Record the percentage of ground cover consisting of exposed unconsolidated mineral matter, including sand, silt, clay, and rock fragments <7.5 cm in diameter.

Organic Matter -- Record the percent of ground covered with organic matter. Exclude from the estimate areas with Decaying Wood greater than 10 cm in diameter; and Bedrock, Cobbles and Stones with an organic layer less than two cm thick.

Water -- Record the percent of ground covered by standing water. If present, also make notes in the Comments section at the bottom of the form as to whether the standing water is

permanent or seasonal, and its general depth.

The total of these six categories should always equal 100 percent. To facilitate an accurate assessment, it is important to make estimates within a representative area of the study site with a minimum size of approximately 300 to 400 m^2, or a 10 to 11 metre radius plot. A 2 x 2 m area will equal one percent in an 11 metre radius plot.

3.2.3 SOILS Information

The information needed for this section of the form can only be obtained from a soil pit dug to a depth of at least 60 cm. Deeper materials can be adequately assessed through the use of a soil probe or auger with practice. Care should be taken not to disturb the ground surface on at least one side of the pit. The point selected for digging should be located on a site representative of the stand's understory vegetation. Except for Depth to Water, all depth measurements are from the mineral soil/litter layer boundary. In the case of Depth to Water, it is measured from the top of the forest floor. Measurements should be to the nearest centimetre.

. *Duff Depth* -- Duff is the accumulated organic material that occurs on the forest floor. It is more technically known as LFH horizons (i.e., litter, fermentation, and humus layers, each representing increasing degrees of decomposition, respectively). Measure and record the total thickness of this material based on the distance from the top of the forest floor to the top of the mineral soil.

. *Hum Frm* (Humus Form) - This classification should be used **for upland sites that are very rapidly to imperfectly drained**. If the site is poorly or very poorly drained, go to the Decomp. Org. Soil category. The extent to which the LFH layers are decomposed, the depth of each layer, and the amount of mixing with the underlying mineral horizons determines the humus form type, of which there are three:

Mor -- This humus type has (i) a relatively thick and undecomposed litter layer, (ii) a matted F or fermentation layer, and (iii) an H may be present but shows

relatively little mixing with the mineral soil and not crumbly.

Moder -- This humus type has (i) an identifiable litter (L) layer, (ii) a fermentation (F) layer that contains fine roots and sometimes fungi, and (iii) a relative thin, crumbly humus (H_i) layer, with evidence of some mineral/organic matter mixing. Humus layers often contain spherical or cylindrical granules that are composed of mixed organic and mineral matter.

Mull -- This humus type (i) lacks a fermentation (F) layer, (ii) has a thin or absent humus (H) layer, and (iii) has a mineral soil horizon with humus, that has been completely decomposed and well integrated with the underlying mineral horizon (an Ah horizon). An Ah horizon is usually dark brown to blackish in color.

- *Decomp. Org. Soils* (Decomposition of Organic Soils) -- **Use this category for poorly and very poorly drained soils.** Decomposing organic matter can be classified into three categories based on degree of decomposition. To determine the degree of decomposition of the dominant organic layer, take a sample of the soil and squeeze it with one hand. Observe the color of the water that seeps through your fingers and compare it with the following criteria:

Of (Fibric) -- Water clear or almost clear, indicating relatively little decomposition. The plants that compose this material are intact and potentially identifiable to species. If the material is rubbed between the thumb and finger it has more than a 40% "rubbed fiber" content by volume.

Om (Mesic) -- Water brown and dirty, indicating decomposition is occurring. The plant material that composes the sample is only partially intact and could only be identified with difficulty. If the material is rubbed between the thumb and finger it has a 10 to 40% "rubbed fiber" content by volume.

Oh (Humic) -- Water black and mucky, indicating a high degree of decomposition has occurred. The plant material is impossible to identify. If rubbed between the thumb and finger, it has less than a 10% fiber content by volume.

Since the types of materials that occur within an organic deposit are often variable, it will be necessary to select a sample for testing that is representative of the soil pit. This sample should come from the upper 30 to 50 cm of the pit.

From a soils classification perspective, an occurrence of organic matter more than 40 cm in thickness is considered an Organic soil (Terric subgroup), while wet soils with less than a thickness of 40 cm are often classified as Gleysols.

- *Seepage* -- Determine if seepage or ground water discharge is occurring on the site. Evidence of seepage could include the occurrence of water seeps, unusually wet ground and hydrophytic plants on sites which should be better drained (e.g., black spruce or white spruce stands with peaty soils on steep slopes). Mark the form that seepage occurs (yes - *Y*), does not (no - *N*) occur, or is suspected (*S*) to occur but could not be clearly determined.

- *Drainage* (Drainage Class) - Soil drainage refers to the rate of water removal in relation to the supply. This drainage scale is based on the potential occurrence of soil moisture in excess of field capacity. Field capacity is the amount of water that a soil can hold after three days of free drainage. Water in excess of field capacity is considered "free water". The prolonged occurrence of free water can result in anaerobic conditions which can create mottles and gleying in the soil. See Table 2 for assistance with identifying drainage classes. Each drainage class is defined as follows:

VR - **Very rapidly drained**: Soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions. Water is removed from the soil very rapidly in relation to supply. Such soils have very limited water storage capacity. Very rapidly drained soils can also be associated with steep slopes.

R - **Rapidly drained**: Soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions. Soils are free from any

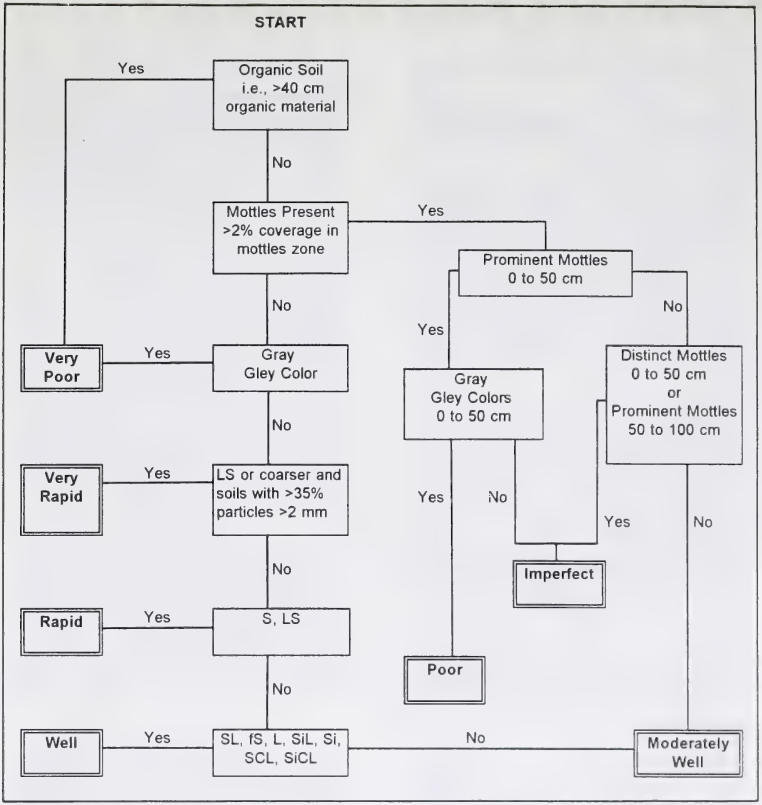


Table 2. Key to soil drainage classes (Source: Anonymous 1985). Texture codes: S - Sand, Si - Silt, C - Clay, L - Loam, and f - fine.

evidence of gleying or mottling throughout the profile and are often associated with steep slopes.

W - **Well drained**: Soil moisture content does not normally exceed field capacity in any horizon for a significant part of the year. Soils are usually free from mottling in the upper 1 metre, but may be mottled below this depth.

MW - **Moderately well drained**: Soil moisture is in excess of field capacity for a small but significant period of the year. Soils may be faintly mottled above 50 cm.

I - **Imperfectly drained**: Soil moisture is in excess of field capacity in subsurface portions of the soil for moderately long periods during the year. Soils are distinctly mottled above 50 cm and can be prominently mottled between 50 and 100 cm.

P - **Poorly drained**: Soil moisture is in excess of field capacity in all horizons for a large part of the year. Soils are usually strongly gleyed or prominently mottled throughout the profile, but may be less strongly developed near the mineral soil surface. Soils are usually in the Gleysolic and Organic orders.

VP - **Very poorly drained**: Free water remains at or within 30 cm of the ground surface most of the year. Prominent mottles or gleying are present within 30 cm of the ground surface, if the organic surface layers are less than 30 cm in thickness.

See Section on Depth to Mottles for definition of faint, distinct, and prominent mottles.

. *Soil Pit Depth* -- Record the distance from the surface of the forest floor to the maximum depth that the soil was examined. This depth would normally correspond to the depth of the soil pit, unless an auger was used to sample the soil below the bottom of the pit.

. *Depth to Water* -- Measure the depth to free standing water from the top of the forest floor. If no evidence of free standing water is observed in the soil pit, mark the provided space with a slash (/). Leave blank if not considered.

. *Depth to Mottles* -- Mottles are caused by anaerobic soil conditions. Mottles indicate that

free water is present in the soil for a significant part of the year. These features are variable in color but are often rust-colored specks. Mottles should significantly contrast with the background matrix color (i.e., they need to be at least "distinct").

To qualify as at least "distinct", mottles should be readily seen and have at least a moderate degree of contrast with the surrounding matrix color. If the mottles and matrix have the same Hue using a Munsell Soil Color Chart (e.g., 5 YR), their colors must differ by at least 2 to 4 units of Chroma, or 3 to 4 units of Value. If the matrix and mottles have Hues that differ by at least 2.5 Hue units (e.g., 10 YR vs 7.5 YR), the mottles will usually be considered at least "distinct".

If the mottling is "perched" (i.e., a zone of distinct mottles over faintly or unmottled soil) due to a dense soil layer that restricts water movement (e.g., a silty loam over clay), circle the "*P*" on the right side of the depth notation. Measure the distance to mottles from the organic/mineral boundary. If no mottles were observed, mark the provided space with a slash (/). If not considered leaved the space blank.

- *Depth to Gleying* -- Gleying is a term used to denote the blue, green, bright gray, and sometimes dark bluish black matrix colors created by anaerobic chemical reactions in water saturated mineral soils. Gleying occurs on sites that have wetter moisture conditions than associated with mottled sites. To qualify as gleyed, the matrix color must typically have a Chroma $\leq$1, or a Chroma $\leq$2 in Hues of 10 YR to 10 R, or a Chroma $\leq$3 in Hues of 2.5 Y or 5 Y based on a Munsell Soil Color Chart. Measure and record the distance from the organic/mineral boundary to gleying. If no gleying was observed, mark the provided space with a slash (/). If not considered leave the space blank.

- *Depth to Calcar.* (Depth to Calcareous Zone) - Measure the depth to calcium carbonates from the top of the mineral soil. Carbonates can be detected by testing the soil profile with a 10% (by volume) HCl solution. Identify as present only if a strong

reaction occurs. This chemical can often be obtained in small quantities from pharmacies.

If carbonates were not observed, mark the provided space with a slash (/). If this variable was not considered, leave the space blank.

. *ERD* (Effective Rooting Depth) - Measure the depth of the effective rooting zone starting at the litter layer-mineral soil boundary. Delineation of this zone is somewhat subjective but it generally considered to end where root abundance decreases to <10 very fine to fine (i.e., <2 mm), or <1 medium (i.e., >2 mm diameter) or coarser roots per 100 square centimetres.

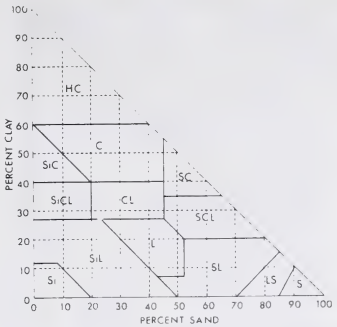
. *Depth to Bedrock* -- Measure the vertical distance between the top of the mineral soil to consolidated bedrock. If no bedrock was observed, mark the provided space with a slash (/); or if not considered, leave provided space blank.

. *Soil Layers* are distinguished on the basis of major compositional differences within a soil profile which include: 1) changes in the proportion of sand, silt and clay; and 2) changes in the abundance of coarse fragments and 3) organic matter. Layers can represent more than one soil horizon as defined in pedology. To delineate soil layers, probe the side of the soil pit at regular intervals (2 cm) with a soil knife from top to bottom. Mark the changes in texture at the point where changes occur in organic content, fines, and coarse materials. Determine the texture, percent coarse fragments, and type of coarse fragments by soil layer. If the layer contains organic matter as indicated by a dark color, mark on the Ecological Assessment Form that an Ah or a buried Ah (i.e., Ahb) occurs. An Ah or Ahb should be more than 2 cm thick to be considered a layer.

. *Depth to* -- If more than one soil layer occurs within the soil pit, determine the vertical distance from the top of the mineral soil to the top of the layer and record this information to the nearest centimeter.

. *Texture* -- Texture is the relative proportion of sand (2.0 to 0.05 mm), silt (0.05 to 0.002 mm) and

clay (<0.002 mm) in a mineral soil sample. Soil texture is best expressed by twelve textural categories as found in a soil textural triangle -



In the absence of expensive laboratory testing, hand texturing is often used to determine which category a soil sample most closely approximates. The field determination of soil texture is subjective and can only be accomplished consistently with training and experience. Two keys are provided to assist in the field determination of texture (Tables 3 and 4). Although these keys are organized differently and use different techniques, their purposes are the same. The choice of a key is a matter of user preference.

The following provides basic guidelines for applying the tests in Table 3. The moisture content is a critical factor in hand texture of soils. The soil sample should be moist. If the sample is too dry, apply water until the appropriate moisture content is obtained. No water should be visible but a small amount of moisture may be present on the palm after the soil sample has been tightly squeezed and then released.

Moist Cast Test - Compress some moist soil by clenching it in your hand. If the soil holds together (i.e., forms a "cast"), then test the durability of the cast by tossing it from hand to hand. The more durable it is, the more clay that is present.

Ribbon Test - Roll soil into a cigarette shape and then squeeze it between your thumb and forefinger to form as long and as thin a ribbon as possible.

Feel Tests - To determine "graininess", rub the soil between your fingers. If it feels "grainy", it is an indication that sand is present. If it feels "floury", it indicates that silts are present.

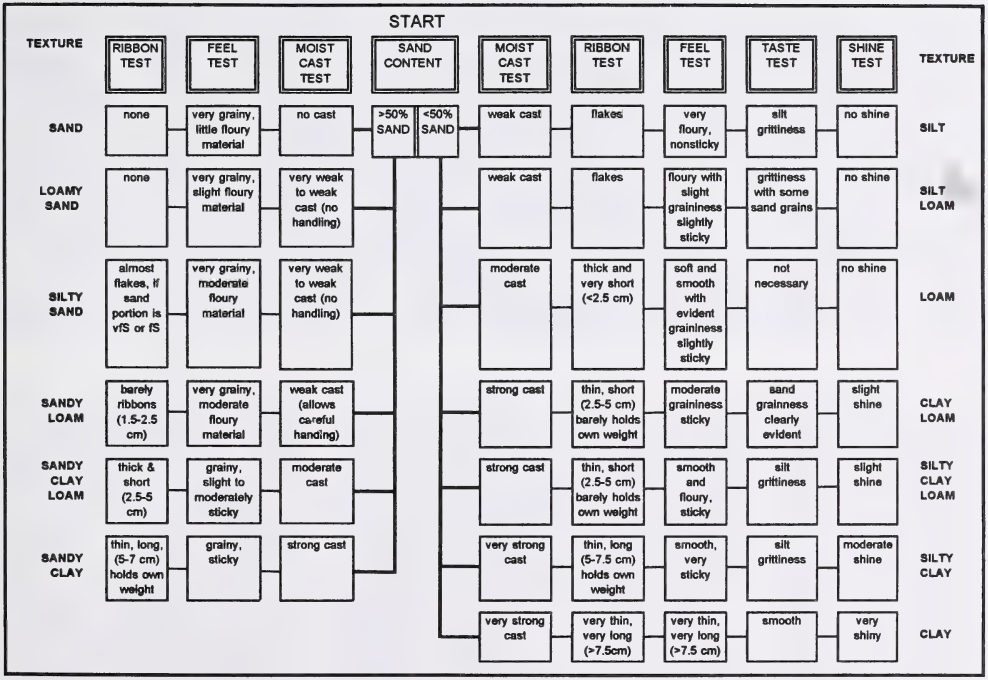
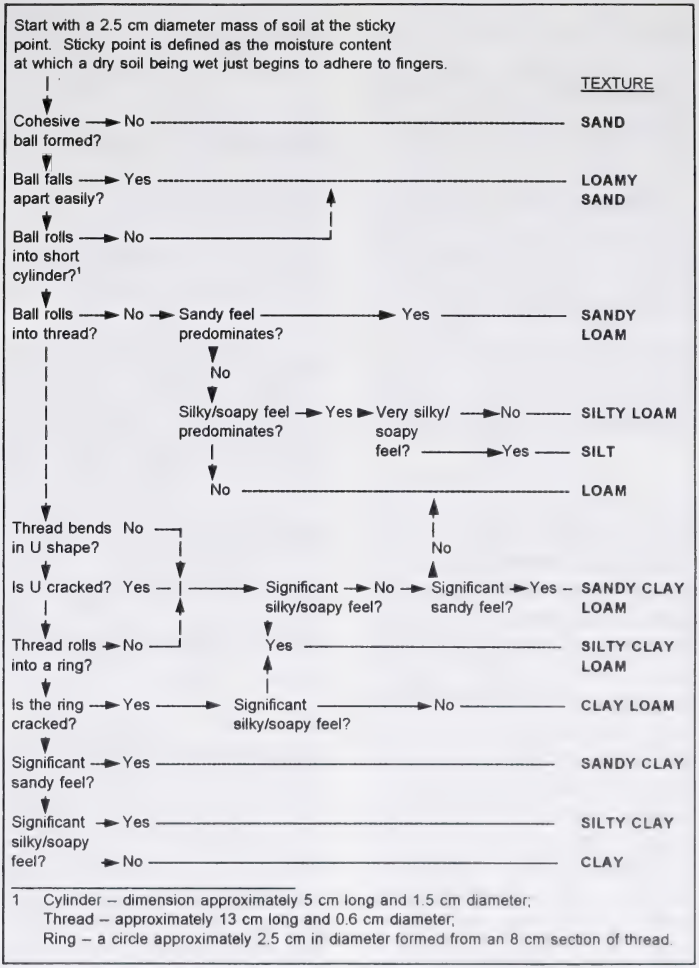


Table 3. Key for hand texturing of soil (Source: Anonymous 1985). Floury material "little" <10%, "slight" 10 to 30%, and "moderate" 31 to 50% by volume.

Table 4. Alternative key for hand texturing of soil (Landon 1988).



1 Cylinder – dimension approximately 5 cm long and 1.5 cm diameter;
Thread – approximately 13 cm long and 0.6 cm diameter;
Ring – a circle approximately 2.5 cm in diameter formed from an 8 cm section of thread.

Stickiness can be determined by wetting the soil thoroughly and compress it between thumb and forefinger. Determine degree of stickiness by noting how strongly the soil adheres to the thumb and forefinger upon the release of pressure, and how much it stretches. Stickiness increases with clay content.

Taste Test - Work a small amount of soil between your front teeth. Silt particles are distinguished as fine "grittiness", unlike sand which is distinguished as individual grains (grainy). Clay is not gritty.

Shine Test - Roll a small amount of moderately dry soil into a ball and rub once or twice with a knife blade. A shine on the ball indicates clay in the soil.

The hand texturing key in Table 4 initially requires that a 2.5 cm mass of soil be wetted to the sticky point. This soil is then manipulated into a ball, cylinder, thread, and ring. The soil is also assessed for its sand and silt content. Some of the characteristics used in this key are the same as those included in Table 3.

. *Coarse Frag. %* (Coarse Fragment Percent) - Estimate the percent of the soil composed of rock fragments with a diameter greater than 2 mm. An easy way of making this determination is to estimate the percent cover of these fragments on the exposed soil cross-section (e.g., one percent equals an area 5 x 5 cm), assuming a 50 x 50 cm soil profile exposure. If coarse fragments were removed from the pit face during digging, adjust estimate accordingly. Alternatively, separate the coarse fragments into different pile by size and estimate their abundance.

. *Coarse Frag. Typ* (Coarse Fragment Type) - Identify the type of coarse fragment that occurs in each soil layer. Coarse fragments include any rock material that is larger than 2 mm in diameter. The best time to observe coarse fragments is during the digging of the soil pit.

G - gravel (2 to 80 mm)
C - cobbles (80 to 250 mm)
S - stones (250 to 600 mm)
B - boulders (>600 mm)

- *Total Ah(b)* -- If Ah and/or buried Ah layers occurred in the soil profile that are less than 2 cm in thickness, record their combined total thickness (e.g., 2+2+1 cm).

3.2.4 VEGETATION Information

Two basic sets of data are required to complete this section of the Ecological Assessment Form. The first section involves the assessment of trees on the study site, while the second involves the assessment of non-tree species. All are based on ocular estimates of percent cover. It can be helpful to mark out a plot (minimum 300 to 400 m^2 recommended for trees and at least 100 m^2 [3.6 m radius] for understory plants) to facilitate the systematic assessment of cover, but not a necessity if the surveyor works within a fixed area to maximize the integrity of the collected data.

- *AVI Cover Type* -- Record the forest cover type associated with the study site (e.g., $C20Sw_9Aw_1$) according to Alberta Vegetation Inventory specifications. This code consists of a canopy closure class (A - 6 to 30%, B - 31 to 50%, C - 51 to 70%, and D - 71 to 100%), height of the tree canopy in meters, and the dominant tree species and portion of the canopy in decile.

- *Stand Age* -- Determine stand age based on an increment boring of a healthy dominant or codominant tree at 1.3 m (DBH) above the ground surface.

- *Vegetation Structure* -- Determine the percent cover of all tree species within a 300 to 400 m^2 study plot:

SW - White spruce
SE - Engelmann spruce
SB - Black spruce
PL - Lodgepole pine
PJ - Jack pine
FB - Balsam fir
FA - Subalpine fir
LT - Tamarack
FD - Douglas fir
AW - Aspen
PB - Balsam poplar
BW - Paper birch

Make these assessments based on the following height classes:

Main Canopy
Understory (>10 m)
Understory (4 to 10 m)
Understory (< 4 m)

Occasionally, it may be appropriate to include tall (>2 m) shrubs in the Vegetation Structure category. For example, willows (*Salix* species) sometimes exceed five meters in height within the Lower Foothills Natural Region. In such cases, record the name of the species in the top row of the Vegetation Structure box and determine its cover by stratum.

Percent cover should be recorded according to the following cover classes:

Class A < 1%
Class B 1 to 5%
Class C 6 to 20%
Class D 21 to 50%
Class E >50%

Cover estimates represent the percentage of ground covered by the foliage of a given species.

. *Understory Vegetation*

There are three main reasons for characterizing the vegetation that occurs beneath a forest canopy:

. to identify characteristic species
. to identify indicator species
. to note problem species

Approximately seventy common shrub, herbs, and nonvascular plant species fall into these three categories (See back of Ecological Assessment Form Table 1). Various keys and guides are available for identifying and learning these species. Among these are the following:

Moss, E.H. 1983. Flora of Alberta, second edition. Revised by J.G. Packer. University of Toronto Press, Toronto, Ontario. (Vascular plant authority for Alberta)

Cormack, R.G.H. 1977. Wild flowers of Alberta. Hurtig Publishers, Edmonton, Alberta.

Corns, I.G.W.; Annas, R.M. 1986. Field guide to forest ecosystems of west-central Alberta. Canadian Forestry Service, Northern Forestry Centre, Edmonton, Alberta.

Looman, J. 1982. Prairie grasses identified and described by vegetative characteristics. Agriculture Canada, Research Branch, Ottawa, Ontario. Publication No. 1413.

Looman, J.; Best, K.F. 1987. Budd's flora of the Canadian prairie provinces. Agriculture Canada, Research Branch, Ottawa, Ontario. Publication No. 1662.

MacKinnon, A.; Pojar, J.; Coupe, R. 1992. Plants of northern British Columbia. Lonestar Publishing, Edmonton, Alberta.

Scotter, G.W.; Flygare, H. 1986. Wildflowers of the Canadian Rockies. Hurtig Publishers, Edmonton, Alberta.

Vitt, D.H.; Marsh, J.E.; Bovey, R.B. 1988. Mosses, lichens & ferns of northwest North America. Lone Pine Publishing, Edmonton, Alberta.

Wilkinson, K. 1990. Trees and shrubs of Alberta. Lone Pine Publishing, Edmonton, Alberta.

For each species present in the study plot (e.g., 100 m^2), provide a cover class code. These cover class codes are the same used for trees. Cover estimates represent the percentage of ground covered by the foliage of a given species. No individual species within a specific stratum can have a total cover of more than 100 percent. However, it is common for all the plants in the understory of a plant community to have a combined total foliar cover greater than 100 percent (e.g., 100 to 300 percent).

Characteristic species are those that typify the forest community in terms of structure and composition. Forest stands are often named on the basis of their characteristic species (e.g., White Spruce/Feathermoss), which are often the dominant or the most abundant species within a stand. Plant community naming often incorporates characteristic species according to stratum. For example, an Lodgepole Pine-Aspen/Green Alder/Stairstep Moss-Knight's Plume Community-type would be composed of a mixed lodgepole pine and aspen overstory with a tall shrub stratum dominated by green alder, and ground cover dominated by a co-dominance of two mosses. A slash (/) between species indicates a change in strata, while a dash (-) indicates a co-occurrence of species within the same vegetation layer.

Indicator species provide clues to environmental conditions within a forest stand. Such plants often indicate relative soil moisture and nutrient conditions. For example, jack pine and bearberry are commonly associated with rapidly and well drained sites in the Central Mixedwood portion of Alberta, while the co-occurrence of white spruce and horsetails often indicates imperfectly to poorly drained sites that are subject to periods of wetness (e.g., flooding, seepage, high water table). Species such as blueberries and Labrador tea are often associated with acidic sites, which would also tend to have a poor nutrient regime. Because the nutrient regime is poor, such sites can also have poor productivity. Greater abundances of species such as bracted honeysuckle, wild sarsaparilla, and dewberry are associated with higher rates of lodgepole pine and white spruce tree growth. However, the absences of a given species on a site is not necessarily indicative of anything and sometimes a species indicator value changes with stand age (Strong et al. 1991) or subregion.

A **problem species** is any species which would have a significant negative impact on silvicultural objectives. Such species are mostly a problem during the early stages of stand development because they compete with crop seedlings for light, water and nutrients. Reedgrass (*Calamagrostis canadensis*) and aspen are well known species that compete with coniferous seedlings on deciduous clearcuts. In some cases, a complex of common species can also create problematic vegetation that inhibits seedling growth until it can extend above the competing canopy, usually the understory vegetation.

3.2.5 SITE CLASSIFICATION

In this portion of the Ecological Assessment Form, various site and vegetation data are synthesized and classified. First the study site must be located with respect to a Natural Region and Subregion. "Natural Regions provide the big picture of Alberta's landscape. The landscape patterns of each region contain a combination of similar vegetation, soil and landform

features." . . . "Subregions are areas with similar landscape patterns that are distinct from other subregions." . . . "Different criteria, matched to the range and scale of natural features that occur in each natural region, are used for separation of the subregions." (Anonymous 1994b, p. 2). Subregions can be further subdivided into ecodistricts according to distinctive physiographic and/or geological patterns.

- *Subregion* -- Six Natural Regions and twenty subregions have been recognized in Alberta. These include the following (Figure 1) -

GRASSLAND REGION

17. Dry Mixedgrass Subregion
18. Foothills Fescue Subregion
19. Northern Fescue Subregion
20. Mixedgrass Subregion

PARKLAND REGION

14. Foothills Parkland Subregion
15. Peace River Parkland Subregion
16. Central Parkland Subregion

FOOTHILLS REGION

10. Upper Foothills Subregion
11. Lower Foothills Subregion

BOREAL FOREST REGION

1. Central Mixedwood Subregion
2. Dry Mixedwood Subregion
3. Wetland Mixedwood Subregion
4. Sub-arctic Subregion
5. Peace River Lowland Subregion
6. Boreal Highlands Subregion

ROCKY MOUNTAINS REGION

7. Alpine Subregion
8. Subalpine Subregion
9. Montane Subregion

CANADIAN SHIELD REGION

12. Athabasca Plain Subregion
13. Kazan Upland Subregion

For the Ecological Assessment Form, it is necessary to identify within which subregion the study area occurs. Write in the space provided the number that corresponds to the appropriate subregion.

- *MR* (Moisture Regime) -- Using Table 5 or 6, determine which moisture regime class the study site most closely approximates based on the previously collected soil and site data. Circle the appropriate number on the form once a class

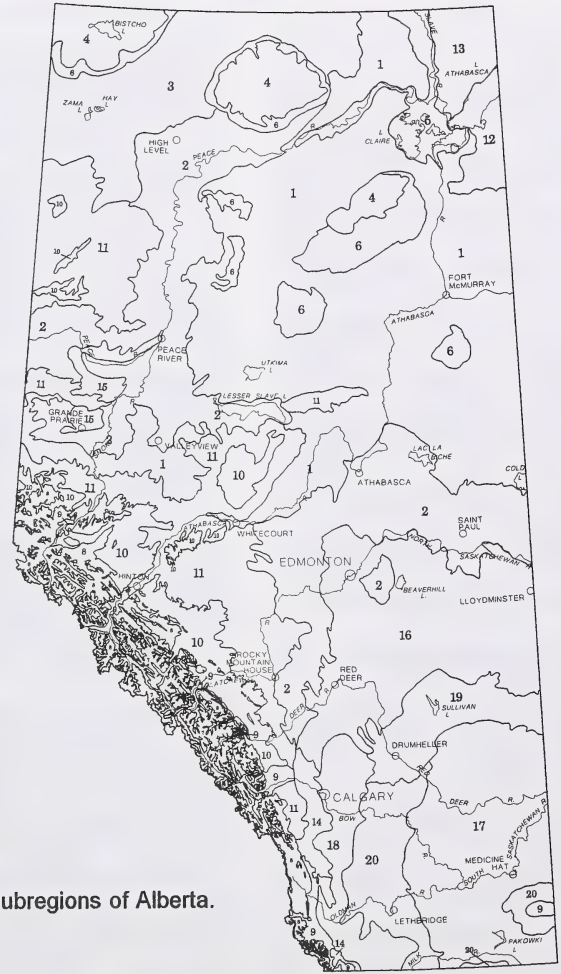
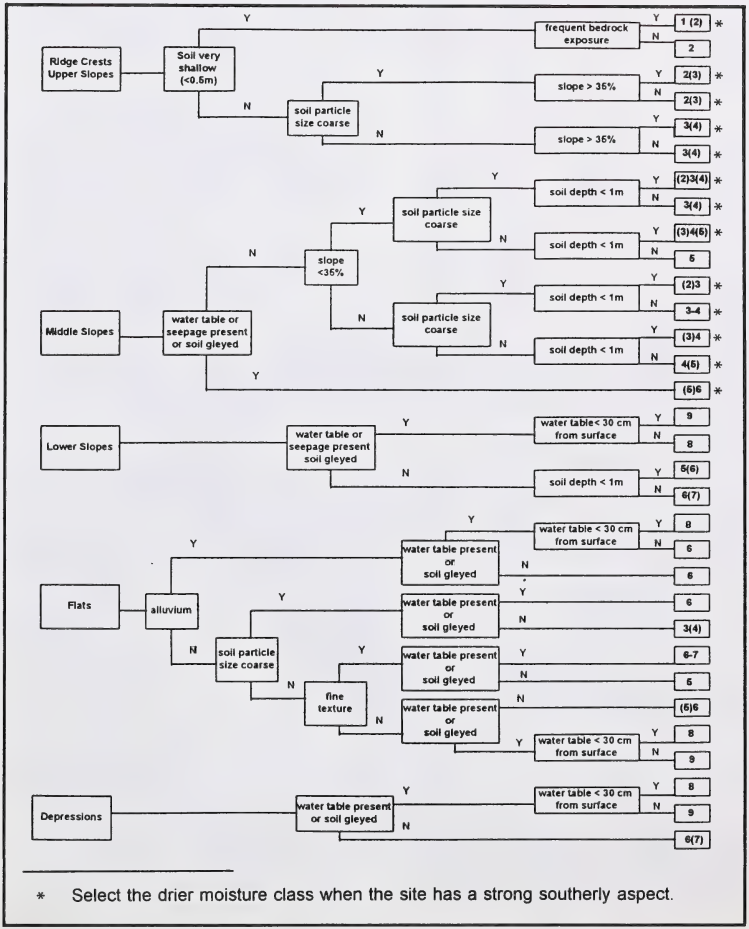


Figure 1
Natural Subregions of Alberta.

Table 5. Ecological moisture regime classes for use in low relief areas (Source: Luttmerding et al. 1990).

	Moisture Regime	Primary Water Source	Slope Position	Texture	Drainage Class	Depth to Impervious Layer	Humus Depth	Water Storage Capacity	Slope Gradient
1	Water removed extremely rapidly in relation to supply; soil is moist for a negligible time after precipitation	Precipitation	Ridge crests; shedding	Very coarse (gravel-S) abundant coarse fragments	Very Rapid	Very Shallow (<0.5 m)	Very Shallow	Extremely Low	Very Steep
2	Water removed very rapidly in relation to supply; soil is moist for brief periods following precipitation								
3	Water removed rapidly in relation to supply; soil is moist for short periods following precipitation		Upper slopes, shedding	Coarse to moderately coarse (LS-SL); moderate coarse fragments	Rapid	Shallow (<1.0 m)	Shallow	Very Low	Steep
4	Water removed readily in relation to supply; water available for moderately short periods following precipitation				Rapid to Well			Low	
5	Water removed somewhat slowly in relation to supply; soil may remain moist for significant but sometimes short period of the year; available soil moisture reflects climatic input	Precipitation in finer textured soils; limited seepage in coarse soils	Mid-slope normal rolling to flat	Moderately fine (L-SiL); few coarse fragments	Well to Moderately Well	Moderately Deep (1-2 m)	Moderately deep	Moderate	Moderate
6	Water removed slowly enough to keep the soil wet for a significant part of the growing season; some temporary seepage and possible mottling below 20 cm	Precipitation and seepage	Lower slopes, receiving	Variable depending on seepage	Moderately Well to Imperfect	Deep (>2 m)	Deep	Variable depending on seepage	
7	Water removed slowly enough to keep the soil wet for most of the growing season; permanent seepage and mottling present; possibly weak gleying	Seepage			Imperfect to Poor	Variable depending on seepage			Slight
8	Water removed slowly enough to keep the water table at or near the surface for most of the year; organic and gleyed mineral soils; permanent seepage <30 cm below the surface	Seepage or permanent water table	Depressions, receiving		Poor to Very Poor		Very deep		
9	Water removed so slowly that the water table is at or above the soil surface all year; organic and gleyed mineral soils	Permanent water table			Very Poor				Flat

Table 6. Key to identifying moisture classes for use in the Rocky Mountains and Foothills area of Alberta (Klinka et al. 1984).



* Select the drier moisture class when the site has a strong southerly aspect.

has been defined.

Table 5 is intended for use in areas such as the boreal forest where local relief is low, while Table 6 is more for mountainous terrain.

- *NR* (Nutrient Regime) -- Using Table 7, determine the nutrient regime class that most closely represent conditions on the study site. Humus Form and A - Horizon Type will commonly be the most important factors in this determination, unless the site has unusual soil conditions (e.g., very stony or thin), or is prone to seepage or has a high ground water table.

  When two nutrient classes could be equally valid as choices based on Table 7, consider the source of the litter that forms the duff. If the litter originates primarily from deciduous trees and shrubs select the more nutrient rich class. The lower class would be selected if the source were primarily evergreens or ericaceous plants. If the understory vegetation is lush and/or rich in species select the more nutrient rich class.

- *Ecosite Code* -- The Ecosite Code represents an ecological synthesis of climate and a variety of site factors. Therefore, it is necessary to conduct the soil and site assessments before attempting to determine an Ecosite Code.

  The Ecosite Code consists of four components: (i) Natural Subregion; (ii) Ecosite; (iii) Ecosite Phase; and (iv) Community-type. In this particular classification system, ecosites are considered ecological units that develop under similar environmental influences (climate, moisture, and nutrients). More specifically, ecosites represent one or more ecosite phases that occur within the same portion of an edatopic grid. The ecosite phase represents a subdivision of the ecosite based on dominant tree species or variations in specific environmental influences.

  It should be noted that the term "ecosite" as used in this classification should not be confused with that used in ecologically oriented landscape mapping within the formally recognized system developed by

Table 7. Nutrient regime characteristics (modified from Klinka et al. 1984).

	A Very Poor	B Poor	C Medium	D Rich	E Very Rich
Humus Form	Mor				
			Moder		
				Mull	
A Horizon	Ae horizon present				
		A horizon absent			
			Ah horizon present		
Soil Texture	Coarse				
			Medium to fine		
Soil Depth	Extremely shallow				
			Very shallow to deep		
Coarse Fragments (%)	High (Sandy soils ≥35%; Loamy soils >70%)				
			Intermediate to low		
Seepage					
Ground Water					
	Stagnant				

the Canadian Forest Service in the late 1960's (Lacate 1969). An ecosite under the Lacate system is defined in Alberta as a unique recurring combination of vegetation, soil, landform, and other environmental components, which are usually mapped at scales larger than 1:20,000 (e.g., Kansas et al. 1993; Usher and Strong 1994).

This Ecosite Code is partially determined through the use of a forest ecosystem field guide. First, proceed to the section of the guide that deals with the appropriate Natural Subregion. Second, using the Edatopic Grid determine which Ecosite Phase(s) most closely approximates the study site based on the previously determined Nutrient and Moisture Regime classes. Once one or more likely Ecosite Phases have been tentatively identified, proceed to the Ecosite Phase chart that follows the Edatopic Grid. Select the most appropriate Ecosite Phase for the study site based on general vegetation composition. For example, if the study site is an aspen stand, it would be more appropriate to select an Aspen/Shrub Ecosite Phase as opposed to a Pine/Shrub or White Spruce/Shrub phase. Within an Ecosite Phase are usually several possible community-types. Select the community-type that appears to best characterize the study site and proceed to the ecological description that accompanies each community-type. Compare the dominant and most abundant species in the community-type description with the vegetation data collected for the study site. If the two correspond, record the associated Ecosite Code on the Ecological Assessment Form (e.g., 11-D2.1). If the community-type description does not fit, return to the previous step and try again. It is possible no appropriate community-type occurs. In this situation, record as much of the Ecosite Code as is appropriate (e.g., 11-D2)

- *Field Guide* – Provide a short title for the field guide used in the assessment and the year of its publication (e.g., Ecosystems Northern Alta 1994).

- *Ecosite Code Fit* – After finishing the selection of a complete (e.g., 11-D2.1) Ecosite

Code record on the form whether you considered the selected option a "good", "fair", or "poor" fit based on a comparision of the community-type description given in the field guide and the vegetation data collected on the study site. This comparison should primarily but not exclusively be based on the dominant species in each stratum of the community.

4.1 INTRODUCTION

In order to save time and money, and to make the survey more effective, it is important that proper preparation be done in advance of the survey. This section provides some suggestions to assist with the completion of an Ecological Assessment Form as part of a pre-harvest survey. The primary preparations can be divided into five categories:

- Pre-planning
- Information collection and interpretation
- Stratification
- Location of Sample Plots
- Logistics

4.2 PRE-PLANNING

Once a decision to do a pre-harvest assessment has been made, several questions must be answered. The following is a partial list of questions which should be addressed prior to the field survey:

- How much land is to be surveyed and where is it?
- What is the purpose of the survey?
- Who is the user?
- What data are to be collected?
- How many plots are required?

4.3 INFORMATION ASSEMBLY

This step helps to ensure that all the pertinent background information has been collected and reviewed prior to the actual field survey. This, in turn, helps the surveyor to understand the range of ecological conditions that occur in the study area and tentatively identifies any major constraints that may be of consideration.

The surveyor should, therefore, compile and review as much existing information pertaining to the study site as possible. Potential sources of information include the following:

- Canada Land Inventory Maps
- Alberta Soil Survey Reports
- Eastern Slope Policy
- Integrated Resource Inventories
- Ecological Land Classifications
- Physical Land Classifications
- Surficial Geology Reports and Maps
- Annual Operating Plans and Maps
- Five-year Development Plans
- Key Wildlife Area Maps
- Recreation Inventory Maps
- Timber Inventory Compilations and Maps
- Air-photos

Policy papers, integrated resource inventories and plans, ecological and physical land classifications are available from the Alberta Government Information Centre, (Main Floor, 9920 - 108 Street, Edmonton, Alberta, Phone 427-3590, FAX 427-9838). Maps and air-photos are available from MAPS ALBERTA (2nd Floor, 9945 - 108 Street, Edmonton, Alberta, Phone 427-7417).

4.4 STRATIFICATION

Two objectives of stratification are (i) to identify and demarcate areas of similar, relatively homogeneous conditions within the survey area, and (ii) to allow the surveyor to become familiar with physical landform, topographic expression, stand composition, drainage, and stocking in the area.

Air-photos are critical in stratifying an area according to landforms and vegetation types. Air-photos can be used to complement ground observations. When stratifying an area, an attempt should be made to delineate areas with similar vegetation and terrain conditions, and areas that differ from surrounding areas. For example, separate areas along significant breaks-in-slope, changes in topographic patterns (e.g., smooth vs hummock), or where distinctively different landforms are evident (e.g., river terraces and slopes vs upland benches). The purpose of such differentiations is to delineate areas with relatively homogeneous site and vegetation conditions which can be used as field sampling polygons. If the terrain and vegetation within an area are relatively homogeneous then the parent materials, soils, drainage, and other conditions should also be similar.

MAPS ALBERTA can use their database to provide information on available photography, scales, film

types, photography dates, and other pertinent information, for any particular location. For purposes of harvesting an area of less than 100 ha, and for most field inspection purposes, photo scales of 1:10,000 to 1:20,000 are generally available and suitable. For regional overviews, smaller scales of 1:40,000 to 1:60,000 are more suitable, particularly for viewing broad topographic patterns and landforms.

4.5 LOCATION OF SAMPLE PLOTS

Initially, determine which polygons require sampling. Plot locations should:

- fall into a representative area within each map polygon with the exact location of the plot determined in the field;
- occur throughout the study area and not grouped within an small portion of the area (e.g., only easily accessible), so a full range of site conditions can be investigated;
- follow a logical sequence in order to facilitate efficient use of field time; and
- allow the surveyor to make note of any site changes in traverses between plots.

5.0 REFERENCES

Anonymous. 1985. Field manual for describing soils, 3rd edition. Ontario Institute of Pedology and University of Guelph, Guelph, Ontario. OIP Publication Number 85-3.

Anonymous. 1987. The Canadian system of soil classification, 2nd edition. Agriculture Canada, Research Branch, Ottawa, Ontario. Publication 1646.

Anonymous. 1994a. Field guide to ecosites - southwestern Alberta. Alberta Environmental Protection, Land and Forest Services, Edmonton, Alberta.

Anonymous. 1994b. Natural regions and subregions of Alberta: Summary. Alberta Environmental Protection. Publication No. I/531.

Beckingham, J.D. 1994. Field guide to the ecosystems of northern Alberta. Prepared for Alberta Environmental Protection by Geographic Dynamics Corp., Edmonton, Alberta.

Corns, I.G.W.; Annas, R.M. 1986. Field guide to forest ecosystems of west-central Alberta. Canadian Forestry Service, Northern Forestry Centre, Edmonton, Alberta.

Kansas, J.L.; Usher, R.G.; Strong, W.L. 1993. Biophysical and land use inventory and analysis of Nose Hill Park. Prepared for City of Calgary, Parks and Recreation by Sentar Consultants Ltd. and Gaia Consultants Inc., Calgary, Alberta.

Klinka, K.; Green, R.N.; Courtin, P.J.; Nuszdorfer, F.C. 1984. Site diagnosis, tree species selection, and slashburning guidelines for the Vancouver Forest Region. British Columbia Ministry of Forests, Victoria, British Columbia. Land Management Report Number 25.

Lacate, D.S., editor. 1969. Guidelines for biophysical land classification. Canada Department of Fisheries and Forestry, Forest Service, Publication 1264.

Landon, J.R. 1988. Towards a standard field assessment of soil texture for mineral soils. Soil Survey and Land Evaluation, 8:161-165.

Luttmerding, H.A.; Demarchi, D.A.; Lea, E.C.; Meidinger, D.V.; Vold, T. 1990. Describing ecosystems in the field. British Columbia Ministry of Environment, Lands and Parks and Ministry of Forests, Victoria, British Columbia. MOE Manual 11.

Strong, W.L; Pluth, D.J.; La Roi, G.H.; Corns, I.G.W. 1991. Forest understory plants as predictors of lodgepole pine and white spruce site quality in west-central Alberta. Canadian Journal of Forest Research, 21:1675-1683.

Usher, R.G.; Strong, R.G. 1994. Ecological land classification for the proposed Suffield National Wildlife Area: First approximation for the northern and southern portions. Prepared for Environment Canada by Gaia Consultants Inc. and Ecological Land Surveys Ltd.